

# Controls for wet heating systems

in small commercial and multi-residential buildings



- Guidance for consultants, heating contractors and building managers
- Sets standards for control functions



ARCHIVED DOCUMENT **ENERGY EFFICIENCY**

**BEST PRACTICE  
PROGRAMME**

## CONTENTS



<b>INTRODUCTION</b>	<b>3</b>
<b>STANDARDS FOR CONTROL FUNCTIONS</b>	<b>4</b>
<b>GUIDANCE</b>	<b>6</b>
Time control functions	<b>6</b>
Temperature control functions	<b>7</b>
Zone control functions	<b>8</b>
Boiler and hot water control functions	<b>9</b>
<b>EQUIPMENT SELECTION</b>	<b>10</b>
<b>BUILDING-RELATED ISSUES</b>	<b>12</b>
<b>TYPICAL APPLICATIONS</b>	<b>13</b>
<b>OTHER ISSUES</b>	<b>14</b>
<b>FURTHER INFORMATION</b>	<b>16</b>

The organisations below endorse this Guide and can provide more detailed information on aspects of design and installation of controls.



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## INTRODUCTION

Poor control of heating and hot water services is responsible for significant over-consumption of energy in many small commercial and multi-residential buildings. In premises with well-controlled systems, heating fuel consumption is typically 15-35% lower.

Good control not only saves energy. It also produces a consistently comfortable environment for a building's occupants – as well as reducing plant maintenance costs. And it means reduced emissions of environmentally damaging gases into the atmosphere.

**SETTING STANDARDS**

This Guide defines standards for Building Regulations, Approved Document L2 (2002)\*, and provides consultants, contractors and building managers with general advice on achieving effective heating control in small, non-domestic buildings such as offices, shops, pubs, hotels, nursing homes, hostels and nurses and student accommodation. It suggests minimum (for Building Regulations) and good practice standards for different system sizes. It also gives guidance on choosing and applying controls. A section on building management systems/intelligent controls has been included as these are now widely applied in smaller premises.

The Guide is only concerned with controls for wet central heating and hot water systems. It does not cover electric heating or warm air systems – or solid-fuel-fired heat sources.

**EXISTING SYSTEMS**

Upgrading controls is often the biggest single improvement that can be made to existing wet heating and hot water systems. Unfortunately, clients and their contractors have not generally specified improved controls when carrying out heating system repairs or boiler replacement. As a consequence, opportunities to upgrade have frequently been missed.

It is essential that contractors always make building managers aware of the potential benefits of controls renewal. Armed with this Guide they are in a position to give clients advice that is independent and endorsed by the Government's Energy Efficiency Best Practice programme. This will encourage more controls upgrades.

**OCCUPANT ADJUSTMENTS**

It is always advisable to give a building's occupants some control over their local environment. Adjustment mechanisms should be simple to use and preferably not permit too great a degree of change. Ideally, settings should be automatically returned to their default levels at the end of each day, though this obviously requires the use of fairly advanced controls. The facility for occupants to adjust the environmental conditions in their workplace or living space is important to both their physical and mental well being.

**HOW TO USE THIS GUIDE**

- *Identify the control functions required using the controls standard table on pages 4-5.*
- *Descriptions of any control techniques you are not familiar with can be found on pages 6-9.*
- *Pages 10 and 11 describe the variety of control equipment available to implement the control functions you need.*
- *Issues specific to building types are addressed on page 12.*
- *Typical applications that may be similar to your own heating/hot water system, or that of your customer, are shown on page 13.*
- *A number of other important issues are discussed on pages 14-15.*

The essence of good control is to operate the heating/hot water system only when needed and to the temperature required – lowering the space temperature setpoint by 1°C can save 5-10% on fuel consumption.

\*This Guide deals with controls for boilers of up to 100 kW. For boilers with an output exceeding 1000 kW, refer to CIBSE Guide H, 2000, Building Control.

## STANDARDS FOR CONTROL FUNCTIONS

### USING THIS SECTION

Assess the boiler size appropriate to the building and decide on the standard of control to apply, ie minimum (for Building Regulations), or good. Then refer to this table, and pages 6 to 9, to find your control requirements.

BOILER OUTPUT		BOILER OUTPUT	
0 kW		25 kW	50 kW
<i>Treat like a domestic system</i> <i>Refer to Good Practice</i> <i>Guide 302</i>		<b>MINIMUM STANDARD*</b>	
<b>TIME</b>		<b>Time control</b> if intermittent occupancy	
<b>TEMPERATURE</b>		<b>Weather compensation</b> adjusts flow temperature in accordance with outside air temperature  <b>Night setback</b> if constant occupancy and appropriate  AND  <b>Zone control of space temperature</b> eg thermostatic radiator valves or thermostatic control such that each functional area (zone) is maintained at the required temperature	
<b>BOILER</b>		<b>Boiler inhibit</b> linking system controls with the boilers to ensure they do not operate when there is no demand for heat	
		<b>GOOD STANDARD</b>	
<b>TIME</b>		<b>Optimum start</b> if intermittent occupancy  AND  <b>Zones timed for occupancy</b> eg motorised valves and time switches	
<b>TEMPERATURE</b>		<b>Weather compensation</b> adjusts flow temperature in accordance with outside air temperature  <b>Night setback</b> if constant occupancy and appropriate  AND  <b>Zone control of space temperature</b> eg thermostatic radiator valves or thermostatic control such that each functional area (zone) is maintained at the required temperature	
<b>BOILER</b>		<b>Boiler inhibit</b> linking system controls with boilers to ensure they do not operate when there is no demand for heat  OR  <b>Boiler energy control</b> combining boiler inhibit with other functions (eg direct weather compensation) and sequence control of multiple boilers	

\*Required by Building Regulations Approved Document L2 (2002)

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## STANDARDS FOR CONTROL FUNCTIONS

The contractor/consultant should always offer the good standard as an option, although the final decision rests with the client. In the case of an existing control system, compare what is installed with the standard and identify the necessary upgrades.

◀	BOILER OUTPUT	▶
50 kW		100 kW†

### MINIMUM STANDARD\*

<b>TIME</b>	<p><b>Optimum start</b> if intermittent occupancy</p> <p>AND</p> <p><b>Zones timed for occupancy</b> eg motorised valves and time switches</p>
<b>TEMPERATURE</b>	<p><b>Weather compensation</b> adjusts flow temperature in accordance with outside air temperature</p> <p><b>Night setback</b> if constant occupancy and appropriate</p> <p>AND</p> <p><b>Zone control of space temperature</b> eg thermostatic radiator valves or thermostatic control such that each functional area (zone) is maintained at the required temperature</p>
<b>BOILER</b>	<p><b>Boiler inhibit</b> linking system controls with the boilers to ensure they do not operate when there is no demand for heat</p> <p>AND</p> <p><b>Sequence control</b> on multiple boiler/heat source installations. This should detect variations in heating demand and start, stop or modulate boilers in combinations which reduce energy use.</p>

### GOOD STANDARD

<b>TIME</b>	<p><b>Zone optimum start</b> where appropriate – eg separate, intermittently occupied buildings</p> <p>AND</p> <p><b>Zones timed for occupancy</b> eg motorised valves and time switches</p>
<b>TEMPERATURE</b>	<p><b>Zone weather compensation</b> eg separate buildings</p> <p><b>Night setback</b> if constant occupancy and appropriate</p> <p>AND</p> <p><b>Zone control of space temperature</b> eg thermostatic radiator valves or thermostatic control such that each functional area (zone) is maintained at the required temperature</p>
<b>BOILER</b>	<p><b>Boiler inhibit</b> linking the system controls with boilers to ensure they do not operate when there is no demand for heat</p> <p>AND</p> <p><b>Sequence control</b> on multiple boiler/heat source installations</p> <p>AND</p> <p><b>Minimise standing losses in heavyweight boilers</b> eg back-end valves, burner or flue dampers</p>

### HOT WATER STANDARDS

#### COMBINED HEATING AND HOT WATER SYSTEMS

**HOT WATER TIME SWITCH**  
Preferably separate from space heating

**HOT WATER THERMOSTAT**

**ALWAYS USE A SEPARATE TIME SWITCH FOR PUMPED SECONDARIES**

#### SEPARATE HEATING AND HOT WATER SYSTEMS

**HOT WATER TIMESWITCH**

**HOT WATER THERMOSTAT**

**ALWAYS USE A SEPARATE TIME SWITCH FOR PUMPED SECONDARIES**

#### LOCAL HOT WATER HEATERS

**HOT WATER TIME SWITCH**

**HOT WATER THERMOSTAT**

#### LOCAL INSTANTANEOUS WATER HEATERS

**SUPPLIED WITH BUILT-IN CONTROLS**

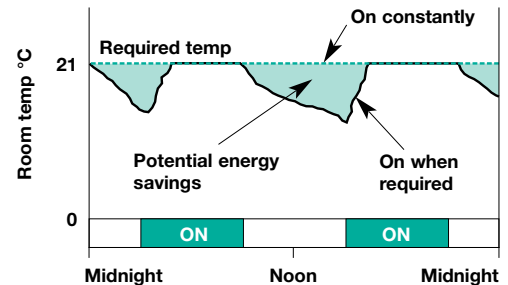
†For boiler outputs of greater than 100 kW refer to CIBSE Guide H, 2000, Building Control

## GUIDANCE – TIME CONTROL FUNCTIONS

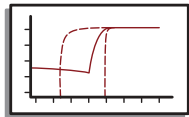
### FIXED TIME CONTROLS



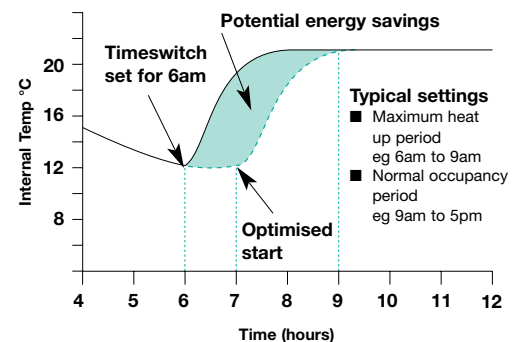
- A time switch (programmer) turns heating or hot water on and off at pre-determined times.
- Time switches should be simple, robust and easily understood.
- Protect controls from tampering/vandalism where applicable.
- Available in daily (24 hrs), weekday/weekend (five/two days), seven-day or 365-day versions. Some feature multiple output channels.



### OPTIMUM START AND STOP CONTROLS



- Optimum start of the heating ensures that the building just reaches its working temperature at the beginning of each occupation period.
- During milder weather heat-up times are reduced, thus saving on energy.
- Most optimisers vary the heating start time on the basis of both space and external temperature readings. Generally they are also self-adaptive in that they 'learn' the thermal response of the building and heating plant.
- Simpler versions only take space temperature into account and are obviously less accurate.
- Optimum stop control is used to switch the heating off as early as possible without compromising comfort conditions. Savings are greatest in well-insulated buildings.



### DELAYED 'OFF' CONTROLS



- These are particularly useful where the heating needs to be extended beyond normal hours (eg evening working in shops) or occupancy in an area is unpredictable (eg in function rooms).
- Heating is switched on by the occupant but automatically switches off after a pre-set period.

See page 12 for some further information relating to time control.

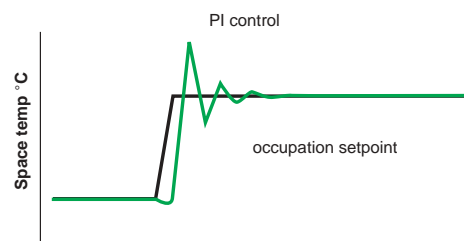


## GUIDANCE – TEMPERATURE CONTROL FUNCTIONS

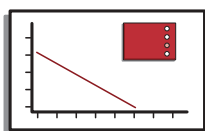
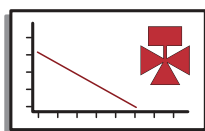
### SPACE TEMPERATURE CONTROL



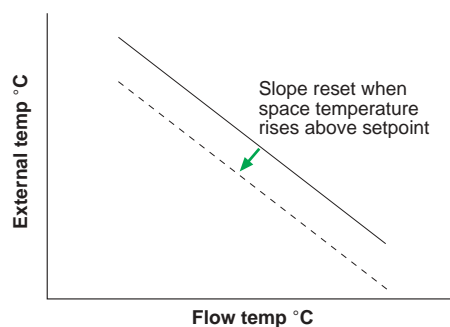
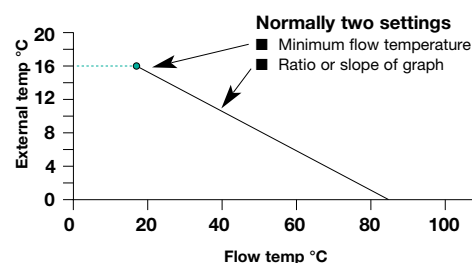
- On/off thermostatic control of heating is often adequate to maintain room conditions within acceptable limits, though it inevitably produces some degree of temperature cycling.
- Modulating control of heating valves offers greater accuracy and results in more stable temperatures. It is commonly implemented using a technique called PI (proportional and integral) control.



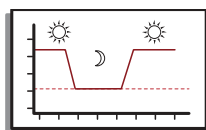
### WEATHER COMPENSATION



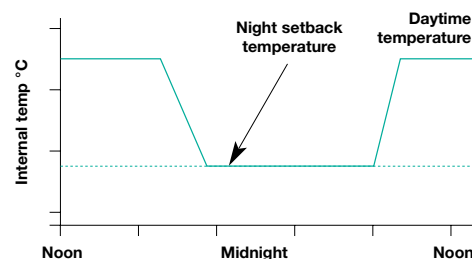
- This automatically adjusts heating circuit flow temperature in accordance with the outside air temperature.
- Energy is saved since flow temperature is reduced during milder weather.
- Weather compensation is generally achieved by controlling the position of a three-port, motorised mixing valve.
- During the heat-up period, when the flow temperature needs to be at maximum, the compensator should be automatically overridden.
- Many compensators shut off the heating above a set external temperature (ambient temperature shutdown).
- Closer control and higher energy savings can be achieved by means of room influence 'trim' of the compensator slope, whereby the flow temperature is reduced in response to an increase in space temperature.
- Direct boiler weather compensation is possible in some applications, but consideration needs to be given to minimum temperature requirements. Also, it is not normally applied if the boiler supplies the domestic hot water system.



### SETBACK



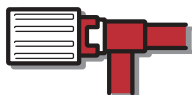
- This reduces (sets back) space temperature during specific time periods, most commonly at night-time.
- It is often part of the weather compensation controls.
- Night setback is mainly applicable to continuously occupied premises, eg nursing homes.



See page 14 for further information relating to temperature control.

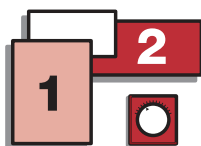
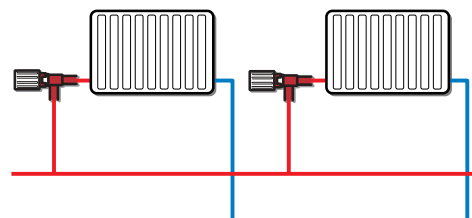
## GUIDANCE – ZONE CONTROL FUNCTIONS

### TEMPERATURE ZONE CONTROLS



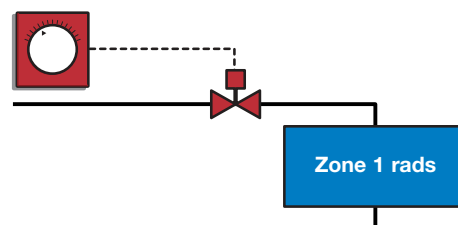
#### Thermostatic radiator valves (TRVs)

- TRVs can provide good local control of temperature in individual rooms.
- They are particularly useful when there are high incidental heat gains, eg from sunshine or equipment.
- It is usually necessary to fit a bypass and regulating valve to ensure a minimum flow through the boiler.
- Remote sensor versions are available for situations where a representative room temperature is difficult to detect.
- Horizontally mounted TRVs give more accurate control as heat transfer from the pipes is lower.



#### Motorised valve control

- Another widely applied form of zone temperature control involves automatic opening/closing of motorised valves using room thermostats or sensor readings.
- Best used with heat emitters totalling more than 5 kW.
- Is most beneficial in areas with high incidental heat gains from sunshine, equipment or occupants.
- North and south-facing sides of buildings are often zoned separately to allow for differences in solar gain (other factors affecting building zoning are discussed on page 14).



#### Weather compensation (see page 7)

- This can be used with zone control, particularly where a boiler supplies a number of buildings or where the building orientation results in a high heat gain on one aspect.

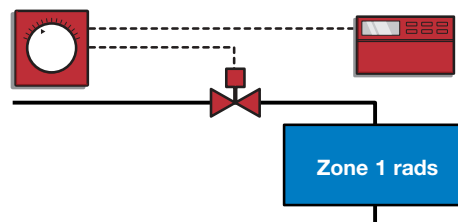
#### Pump speed control

- Variable speed pumping can be worth using in combination with zone temperature control, especially in larger buildings. Energy is saved by cutting pump speed in response to reduced demand, ie the throttling back of TRVs or zone motorised valves. Because heating systems normally require maximum flow for a relatively short time every day (during the boost period), the savings can be appreciable.

### TIMED ZONE CONTROLS



- Independent time control of zones prevents areas/rooms being heated unnecessarily.
- Programmable thermostats, which combine the role of time switch and room thermostat, can be a convenient way of achieving time and temperature control.
- Special TRV/time controls and multiple-zone time control systems are also available.



See page 14 for further information relating to zone control.

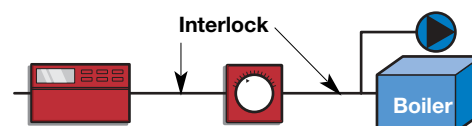


# GUIDANCE – BOILER AND HOT WATER CONTROL FUNCTIONS

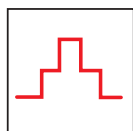
## BOILER INHIBIT



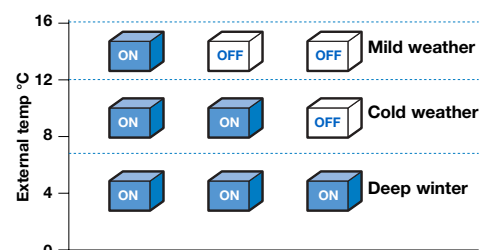
- Most boilers are supplied with packaged controls whose principal function is to maintain the desired boiler flow (outlet) temperature by means of burner firing control (generally on/off or high/low/off).
- Boiler inhibit involves connecting the system controls to the firing controls to ensure the boilers do not operate when there is no demand for heat. The basic principle is shown opposite.
- In smaller systems (less than 50 kW) this can be achieved using a reference room thermostat (and cylinder thermostat) between the time controls and the boiler – or by a multi-functional controller.
- In larger systems it normally involves hardwired links and/or software interlocks (within a multi-functional controller).



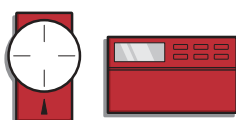
## BOILER SEQUENCE CONTROL



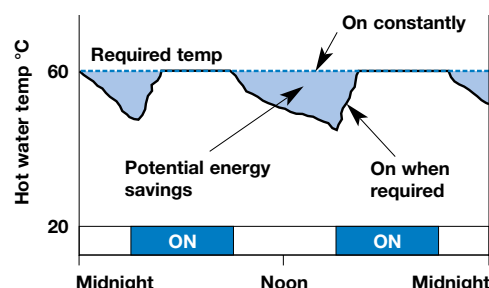
- Sequence control ensures that the number of boilers/burners on-line is matched to the heating demand, thereby maximising overall efficiency.
- It can be carried out by a dedicated sequencer or a multi-functional controller.
- Good sequence control avoids short cycling of burner operation.
- Rotation of boiler order evens out wear and can be done manually or automatically.
- When there are both condensing and ordinary boilers, the former type should always take the lead. Similarly, if there is combined heat and power (CHP) unit, this should be the lead heat source.



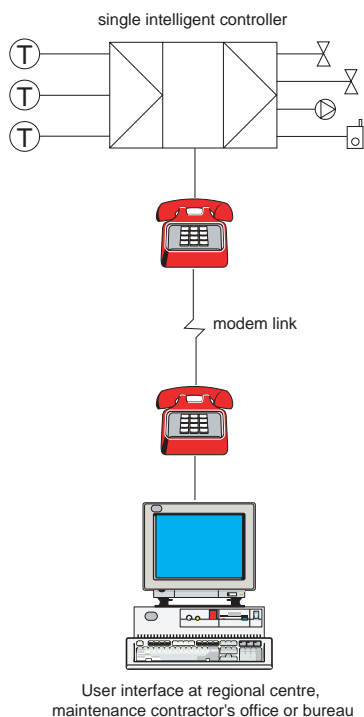
## HOT WATER CONTROLS



- Always use time controls to ensure hot water is only available when required.
- Always use thermostatic or other controls to maintain hot water at the required temperature.
- To prevent scalding at the draw-off points, the use of fail-safe mixing valves should be considered.
- See page 15 for sources of information on controlling bacteria such as legionella.



## EQUIPMENT SELECTION



Having decided on the control requirements for the system, it is necessary to select equipment to carry out the desired functions.

### COMPONENT CONTROLS

Traditionally, separate components have been used to carry out each function, hard-wire inter-linked as appropriate when the functions need to be integrated. Existing systems may adopt this approach, and when they are upgraded, the equipment choice may depend on the state of these existing controls. If there are one or two individual controls that are working well, then consider retaining them and adding more. However, if they are poor, the opportunity should be taken to replace them with a multi-functional controller or building management system (BMS) depending on the size of the building.

### BUILDING MANAGEMENT SYSTEMS

Some or all of the functions described on the preceding pages can often be integrated into a single BMS. For larger and new buildings, this is particularly relevant and likely to offer an appropriate and cost-effective solution.

BMSs have become more user-friendly in recent years, with intuitive displays which can be understood readily by the contractor and the building user. They can be no more complex to install and commission than component controls where several control functions need to be integrated. A BMS can also offer additional functions, such as logging of system and energy data, and remote access for adjustments.

At the heart of all modern BMSs are microprocessor-based control and monitoring units which are variously described as intelligent controllers, BMS outstations or direct digital controllers. These units have two distinguishing features – they are freely programmable and capable of data communications.

Being programmable, an intelligent controller can be exactly configured to meet the needs of a particular application. The control strategy can be re-configured at any time, eg if there were changes to the heating system or building's operation.

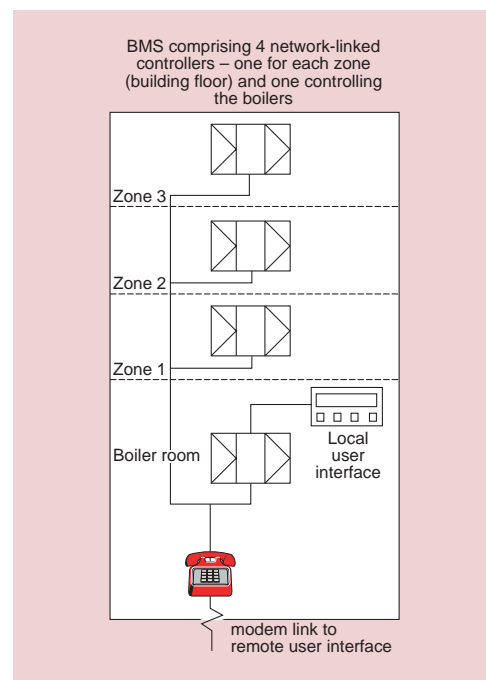
Because they can communicate, controllers can be networked together to form a single integrated system, which would also incorporate one or more user interfaces. If required, a user interface can be located remotely and connected via auto-dial modem. Where appropriate, controllers can interact to provide more energy-efficient control. In small buildings with simple heating systems, a single controller may be all that is necessary.

### MONITORING AND ADJUSTMENT

A BMS's monitoring/adjustment facilities represent its main advantage over stand-alone non-communicating controls. From a conveniently located single point it is possible to adjust any control setting and view all controller-monitored data relating to environmental conditions and the status of the heating plant and other building services.

### TRAINING

Training can take anything from one or two hours to a couple of days, depending on the individual's level of knowledge. Training for more than one operator is essential.



# EQUIPMENT SELECTION

<p><b>EXAMPLES OF SINGLE-FUNCTION CONTROLS</b></p> <p>Suitable when upgrading existing controls, particularly in small buildings with simple heating systems</p>	<p><b>EXAMPLES OF FIXED APPLICATION, MULTI-FUNCTIONAL CONTROLS</b></p> <p>Modular approach that is often cheaper and makes for easier installation than individual controls</p>	<p><b>PROGRAMMABLE, MULTI-FUNCTIONAL CONTROLLER OR BMS</b></p> <p>Suited to most types and sizes of building; represents best approach in larger and more complex premises</p>
<p><b>TIME</b></p> <div data-bbox="156 813 304 907"></div> <p>Optimum start control</p> <div data-bbox="169 969 304 1052"></div> <p>Programmer</p>	<div data-bbox="675 763 904 936"><p><b>Combined optimum start control and weather compensator</b></p></div> <div data-bbox="718 974 866 1066"></div> <div data-bbox="718 1149 866 1240"></div>	<div data-bbox="1166 801 1315 896"></div> <div data-bbox="1166 999 1315 1090"></div> <div data-bbox="1161 1173 1305 1272"></div>
<p><b>TEMPERATURE</b></p> <div data-bbox="169 1211 317 1303"></div> <p>Weather compensator</p> <div data-bbox="164 1359 309 1460"></div> <p>Temperature zone controls</p>	<div data-bbox="675 1352 904 1507"><p><b>Boiler energy control</b> including optimum start control and direct boiler compensation</p></div> <div data-bbox="722 1534 861 1621"></div> <div data-bbox="735 1644 842 1751"></div> <div data-bbox="715 1771 863 1863"></div>	<div data-bbox="1182 1359 1289 1464"></div>
<p><b>BOILER</b></p> <div data-bbox="150 1590 256 1695"></div> <p>Boiler inhibit</p> <div data-bbox="150 1758 248 1854"></div> <p>Boiler sequencer</p>	<div data-bbox="722 1534 861 1621"></div> <div data-bbox="735 1644 842 1751"></div> <div data-bbox="715 1771 863 1863"></div>	<div data-bbox="1190 1547 1286 1644"></div> <div data-bbox="1171 1720 1311 1807"></div>

The controls shown are only examples; other combinations are available.

## BUILDING-RELATED ISSUES

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### MULTI-RESIDENTIAL BUILDINGS AND HOTELS



- Introduce night setback or, if possible and more economic, turn the heating off completely overnight.
- Ensure that a single small demand for heat does not turn all the plant on at night.
- Since these buildings have different usage/occupancy patterns in different areas, ensure that they are zoned correctly (see page 14).
- Ensure that communal areas are only heated during the day when actually in use.
- Such buildings usually have high hot water consumption; close control of the hot water services is thus especially important.
- Residents have a wide range of individual temperature requirements, which may be best met using TRVs.
- For safety, low-temperature emitters are required in nursing and residential homes. Condensing boilers, which give very high efficiencies at low system temperatures, are ideal for such locations.
- Consider installing underfloor heating, which is safe, unobtrusive and not subject to vandalism.

### SMALL COMMERCIAL BUILDINGS (OFFICES, SHOPS AND PUBS)



- Buildings of this type almost always require intermittent heating; install optimum start/stop controls to reduce energy use at the beginning and end of the day.
- In well-insulated, airtight, thermally heavyweight buildings, consider maintaining low-level ('trickle') heating outside normal occupancy.
- Avoid one room or zone (eg the managing director's office) dictating the demand patterns for the whole building.
- Try to operate stock rooms at lower temperatures, using zone controls to achieve this.
- Make sure the control system can be used to find a balance between the different requirements of staff and customers.
- Staff often feel more comfortable if they can control their own environment.
- For half-day closing of shops install time controls that are flexible enough to save on heating.

### ADVICE TO MANAGERS AND OCCUPANTS

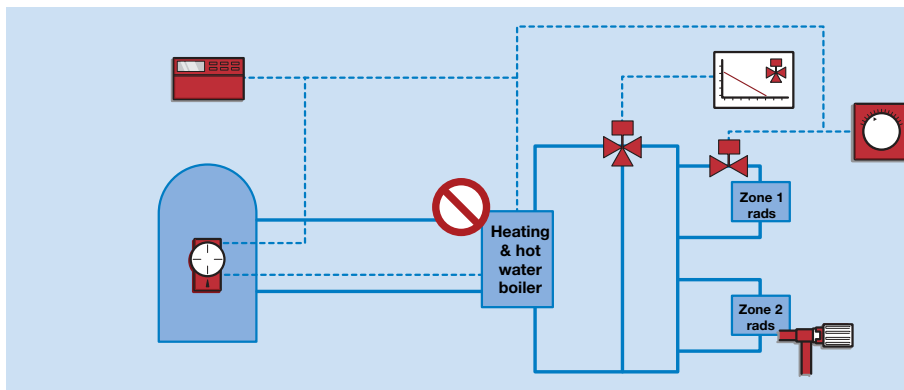
Contractors should explain clearly how to set and use new controls. Over time, incorrectly set controls can lead to much increased energy consumption.

It is strongly recommended that the building manager keep a record of the control settings. Where appropriate, these should be displayed near to the controls themselves so that the latter can be returned to their optimum settings if tampered with. If necessary, use tamper-proof controls or mount them in a tamper-proof box. Intelligent controls can be password protected to limit or deny access to settings.

A copy of the manufacturers' instructions should always be left with the occupant. The controls supplier/contractor should also do the following:

- show how the time controls are set
- show how to check for correct operation of weather compensation and optimum start controls
- explain how to set summer hot water only
- demonstrate adjustment of space temperature controls, and explain their function
- explain the layout of the heating zones and the advantages of maintaining zone integrity by closing interior doors
- stress the energy-saving features of the control routines applied.

## TYPICAL APPLICATIONS

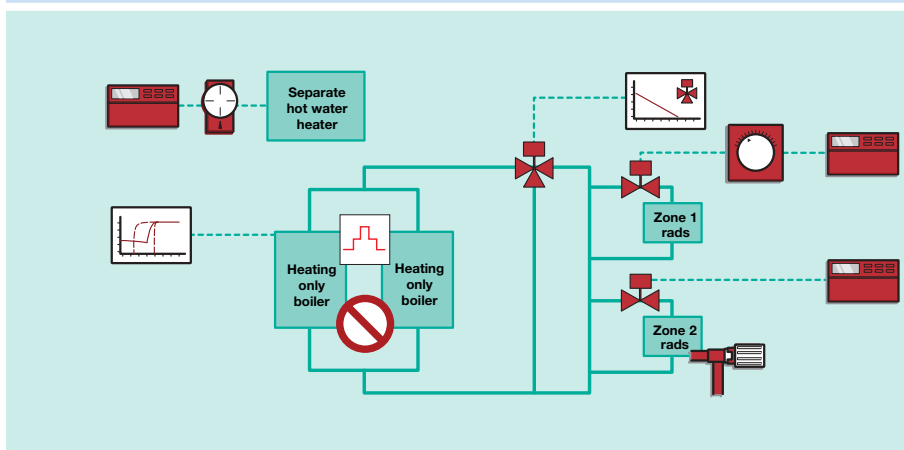


### SMALL OFFICE

A single small boiler supplying heating and hot water

#### Minimum standard under 50 kW

Time controls, cylinder thermostat, zone temperature control, boiler inhibit and weather compensation

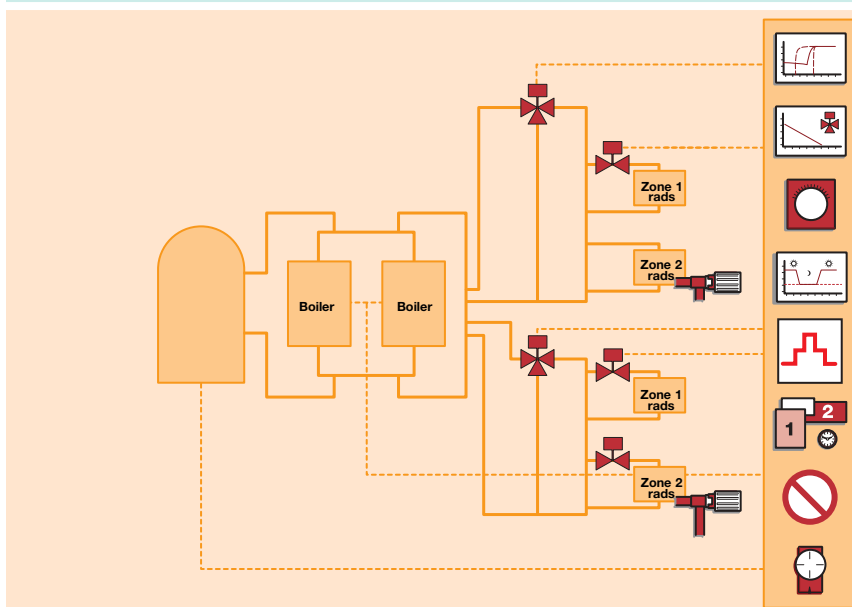


### NURSES HOME / MEDIUM-SIZED SHOP

Multiple small boilers and a separate hot water heater

#### Good standard under 50 kW

Optimum start control, weather compensation, time and temperature zone control, boiler inhibit and sequencing, and separate time and temperature controls for the hot water heater (to suit occupancy)



### NURSING HOME

Multiple boilers supplying both heating and hot water

#### Good standard over 50 kW

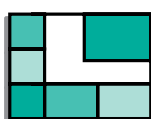
BMS includes boiler inhibit and sequencing, optimum start/stop, night setback, weather compensation of larger zones and separate hot water controls

These are just a few examples of how the control standards can be applied in practice. For clarity, some details have been omitted (eg pumps and certain valves). See references on the back page for further design information.

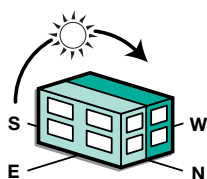
## OTHER ISSUES



*Most small commercial and multi-residential buildings will divide into at least two or three simple zones*



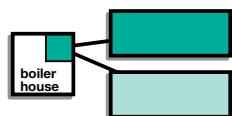
*Multi-tenanted buildings provide an ideal opportunity to zone on the basis of tenants*



*The orientation of the building may suggest north/south or east/west zoning*



*Multi-storey buildings can also be zoned floor by floor*



*Multiple buildings served by the same boiler house can be zoned separately*

### BUILDING ZONING

Splitting a heating system into multiple zones allows different parts of a building to be heated to different temperatures and/or at different times.

Zone control gives most benefit in larger or poorly insulated buildings, particularly when applied to areas with different occupancy, use or construction.

Zone control should be considered when there are:

- different occupancy patterns
- different temperature requirements
- more than one tenant
- a number of floors (particularly where top floors are poorly insulated)
- a building orientation that creates differences in heat gains and losses
- more than one building
- obvious separate circuits in the heating system.

Control zones should be chosen to meet the needs of the occupants and related to the building and heating system layouts. If required, further zones can be added at a later date. Random zoning is of no benefit at all.

The various means of zone control (see page 8) can be used in combination to satisfy the differing needs within a building. For example, there could be weather compensated east/west zones to provide climatic control, TRVs for individual occupant control and automatically controlled motorised valves to make meeting rooms into timed zones.

### SITING ROOM THERMOSTATS AND SENSORS

Correct siting of room thermostats and space temperature sensors is essential for accurate control.

- Their position must be representative of room temperature and not influenced by any external or internal heat sources.
- They should be positioned at approximately head height.
- Air must be able to circulate freely around them.
- Internal sensors for optimum start control should be located in the coldest part of the building served by the heating system.

### SITING EXTERNAL SENSORS

External sensors also need careful siting:

- out of direct sunlight on a north-facing wall
- away from heat sources such as opening windows, extract ducts and chimney stacks
- sheltered from the rain and wind
- on a wall not subject to high internal heat gains.

### FABRIC/FROST PROTECTION

The heating controls should protect the building, its contents, plant and pipework, from frost and condensation damage. They should automatically bring on the heating when the space, external air or return water temperatures fall to pre-set minimum levels. In the case of simple controls a separate thermostat may need to be fitted. Frost protection space sensors/thermostats should be installed in the fastest cooling or most vulnerable part of the building.

### BOILER SIZING

Boilers should not be sized by calculating radiator sizes in each room, totalling them up and adding the hot water cylinder capacity, nor should they be replaced on a like-for-like basis. Substantial oversizing and a consequent decrease in seasonal efficiency are likely to result in both cases. Use a traditional sizing method based on a whole building heat loss calculation. Condensing boilers should always be considered, both for new buildings and system upgrades.

### BOILER ANTI-CYCLING CONTROLS

Stand-alone anti-cycling controls reduce the boiler firing cycle rate by increasing the off time. Basic versions introduce a time delay that is either fixed or varies on the basis of return water temperatures. Their use is not generally recommended as they provide little or no improvement over the minimum level of control shown in this Guide.

### COMMISSIONING

If a heating system is to operate as intended it must be properly commissioned. The process should include checking water soundness, flushing the system, setting up the boilers, balancing the circuit flow rates and testing the functioning of the controls. All components should be checked to ensure their installation is in accordance with the manufacturers' instructions.

## OTHER ISSUES

It is particularly important that sufficient time and resources are allowed for commissioning of the controls. Since this is always done last, it is a part of the process that often gets squeezed. The tuning of control loops is one key task that can get neglected owing to pressure of time.

To achieve optimum performance, further adjustment of the controls is often necessary once the system is fully operational and has had to perform under varying climatic conditions. For instance, weather compensators and optimisers may need to be gradually tuned to find the best settings. With intelligent (BMS) controls, making adjustments and monitoring their effects can be carried out remotely, eg from the contractor's offices.

**MAINTENANCE**

Heating and hot water systems require regular maintenance to ensure safe and efficient operation. Boilers need to be maintained in accordance with manufacturers' instructions and their efficiency periodically checked. It is also vital that the heating controls are subject to regular check-ups.

If maintenance is ignored, controls tend to suffer a gradual degradation, which will affect comfort conditions and energy efficiency levels. This deterioration can be caused by a number of factors, such as controls being permanently overridden and by failure to adjust control settings when building usage or occupation patterns change. Regular inspections are also necessary to check the operation of valve actuators and the condition and accuracy of sensors.

Though the functioning of intelligent (BMS) controls can be monitored from a distance, site visits should still be carried out.

**OPERATIONAL MANAGEMENT**

A BMS can assist the building user to manage the operation of the system. The main system user interface is often a PC-based graphical software package that displays current data on plant and building schematics.

- Plant faults and other alarms are automatically displayed and/or printed as soon as they occur.
- Monitored data stored within the system can make it easier to diagnose faults. It may also reveal sources of energy waste that might otherwise go unnoticed.
- System access can be password protected to prevent unauthorised adjustment. However, a building's occupants should be given some degree of control of their environment, eg local temperature control dials (wired to the system controllers).
- The option to have a remote user interface (eg at the plant maintenance contractor's office or a regional HQ) is especially important in small buildings, where there are likely to be no engineering or facilities management staff.
- User interfaces can be relatively simple devices, possibly comprising just a keypad and single line alpha-numeric display built into a controller.

**ENERGY MONITORING**

If energy usage is not measured, then it cannot be effectively managed. It is thus advisable to monitor the energy consumed by the heating system. Consumption figures should be compared with a 'good practice' energy benchmark for a building of the same type and size.

Intelligent controls, such as a BMS, are able to monitor consumption directly, assuming the necessary metering equipment is in place.

**LEGIONELLA**

Uncontrolled microbiological contamination of hot water systems contravenes health and safety legislation and can lead to outbreaks of legionnaires' disease. An approved code of practice and guidance on the control of legionella bacteria in water systems has been produced by the Health and Safety Commission (see back page). Advice on the design, commissioning and maintenance procedures necessary to minimise the risk of infection from legionella being caused by the services within a building has been published by CIBSE (see back page).





## FURTHER INFORMATION

### ENERGY EFFICIENCY BEST PRACTICE PROGRAMME

#### Good Practice Guide 302

Upgrading controls in domestic wet central heating systems – a guide for installers

#### General Information Report 40

Heating systems and their control

#### Fuel Efficiency Booklet 10

Controls and energy savings

#### Energy Consumption Guide 19

Energy use in offices

#### British Standards Institution

389 Chiswick High Road, London W4 4AL

Tel 020 8996 9001

Website [www.bsi.org.uk](http://www.bsi.org.uk)

- Code of practice for low-temperature hot water heating systems of output greater than 45 kW. British Standards BS 6880, 1988

#### Health and Safety Executive

HSE Books, PO Box 1999, Sudbury

Suffolk CO10 6FS

Tel 01787 881165

Website [www.hsebooks.co.uk](http://www.hsebooks.co.uk)

- L8: The prevention or control of legionellosis, 2000 (ISBN 0-7176-1772-6)

#### Building Services Research and Information Association

Old Bracknell Lane West, Bracknell

Berkshire RG12 7AH

Tel 01344 426511

Website [www.bsria.co.uk](http://www.bsria.co.uk)

- AG 7/98 Library of system control strategies, A J Martin, C P Maynard
- AG 14/99 Variable speed pumping in heating and cooling circuits, C J Parsloe
- TN 6/98 Specifying building management systems, K Pennycook, G Hamilton

#### The Stationery Office

51 Nine Elm's Lane, London SW8 5DR

Tel 0870 600 5522

Website [www.ukstate.com](http://www.ukstate.com)

- The Boiler Efficiency Regulations (1993) (ISBN 0-11-034046-9)
- Building Regulations 2000, Approved Document L1, 'Conservation of fuel and power in dwellings' (2002)

### FURTHER READING

#### The Chartered Institution of Building Services Engineers

222 Balham High Road, Balham

London SW12 9BS

Tel 020 8675 5211

Website [www.cibse.org](http://www.cibse.org)

- CIBSE Guide H: Building Control Systems, 2000
- TM13: 2000 Minimising the risk of Legionnaires' Disease

#### Oil Firing Technical Association for the Petroleum Industry

Century House, 100 High Street, Banstead

Surrey SM7 2NN

Tel 01737 373311

Website [www.oftec.org](http://www.oftec.org)

- Design, Operating Principles and Energy Efficiency, Technical Book 4, 1998

The revision of this Guide is based on material drafted under contract to BRECSU for the Energy Efficiency Best Practice programme.

### The Government's Energy Efficiency Best Practice programme

provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at [www.energy-efficiency.gov.uk](http://www.energy-efficiency.gov.uk)

Call the Environment and Energy Helpline on **0800 585794**

**Energy Consumption Guides:** compare energy use in specific processes, operations, plant and building types.

**Good Practice:** promotes proven energy-efficient techniques through Guides and Case Studies.

**New Practice:** monitors first commercial applications of new energy efficiency measures.

**Future Practice:** reports on joint R&D ventures into new energy efficiency measures.

**General Information:** describes concepts and approaches yet to be fully established as good practice.

**Fuel Efficiency Booklets:** give detailed information on specific technologies and techniques.

**Introduction to Energy Efficiency:** helps new energy managers understand the use and costs of heating, lighting, etc.